Effects of State-Dependent Forward Guidance, Large-Scale Asset Purchases and Fiscal Stimulus in a Low-Interest-Rate Environment

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Motivation

- The Global Financial Crisis, the secular fall in the equilibrium real interest rate, and the protracted period with nominal interest rates at their effective lower bound (ELB) have led to a re-assessment of the incidence and severity of ELB episodes.
- Central banks have gained considerable experience with the use of non-standard monetary policies such as forward guidance about the future path of interest rates and large-scale asset purchases.
- There is an increasingly widespread call for fiscal policy to stimulate the economy once interest rates have fallen to the ELB.

What we do

- In the years prior to the financial crisis, and in its aftermath, a considerable number of model-based studies were carried out to gauge the extent to which the ELB impairs overall macroeconomic outcomes:
  - Reifschneider and Williams (2000), Coenen et al. (2004), Williams (2009), Chung et al. (2012) for the US economy
  - Coenen (2003) for the euro area economy
- We construct steady-state distributions for euro area inflation and economic activity under different assumptions for the equilibrium real interest rate, r^*:
  - gauge the impact of lower values of r^* on the central bank's ability to stabilise inflation and the output gap under the ELB
  - evaluate the extent to which state-dependent FG, AP and G can ameliorate the adverse effects stemming from the ELB

Our modelling framework

- We use the recent extension of the ECB's New Area-Wide Model of the euro area (NAWM II; Coenen et al., 2018): ▸ Model
  - accounts for a *genuine role of financial intermediaries* in the propagation of economic shocks and for the presence of shocks originating in the financial sector itself
  - captures the *prominent role of bank lending rates* and the gradual interest-rate pass-through in the transmission of monetary policy in the euro area
  - provides a structural framework for assessing the *macroeconomic impact of the ECB's large-scale asset purchases*

Related literature

- Studies documenting the fall in the equilibrium real rate:
  - Laubach and Williams (2016), Hamilton et al. (2016), Holston et al. (2017), Brand et al. (2018), Jordà and Taylor (2019)
- Analyses of non-standard monetary policies:
  - Engen et al. (2015), Reifschneider (2016), Kiley and Roberts (2017), Harrison (2017), Kiley (2018), Burlon et al. (2018), Chung et al. (2019), Debortoli et al. (2019), Sims and Wu (2019)
- Analyses of alternative monetary policy frameworks (not addressed):
  - Bernanke (2018), Bernanke et al. (2019), Harrison et al. (2019), Mertens and Williams (2019), Andrade et al. (2019)
- Calls for using fiscal policy as an additional stabilisation tool:
  - Blanchard (2019), Eichenbaum (2019), Rachel and Summers (2019)

State-dependent policy rules: FG

- We focus on history-dependent interest-rate rules which lead to "low for longer" policy prescriptions:
  - Reifschneider and Williams (2000): rule depends on the *cumulated value* of past shortfalls of the *shadow interest rate* below the ELB
  - Debortoli et al. (2019): rule depends on the *lagged value* of the shadow-rate shortfall
- We do not consider:
  - threshold-based rules (Boneva et al., 2018; Burlon et al., 2018; Chung et al., 2019; Coenen and Warne, 2014)
  - price-level targeting rules (Vestin, 2006; Bernanke, 2018; Bernanke et al., 2019), or average-inflation targeting rules (Nessén and Vestin, 2005; Mertens and Williams, 2019)
- We keep the central bank's inflation objective (determining inflation in the model's deterministic steady state) constant at 1.9%.

State-dependent policy rules: FG (cont'd)

- We center the state-dependent policies around the model's estimated (log-linear) interest-rate rule taking into account the ELB constraint:

$$r_t \;=\; \max[\,\tilde{r}_t,\, -100\cdot\log(\bar{R}) + \mathit{ELB}\,]$$

with

$$\begin{aligned}\tilde{r}_t \;=\;& \phi_R\,(\iota\, r_{t-1} + (1-\iota)\,\tilde{r}_{t-1}) \\ &+ (1-\phi_R)\left(r^r_{t|t} + \phi_{\Pi_C}\,\pi_{C,t} + \phi_Y\, y_t\right) \\ &+ \phi_{\Delta\Pi_C}\,(\pi_{C,t} - \pi_{C,t-1}) + \phi_{\Delta Y}\,(y_t - y_{t-1}) + \eta^R_t,\end{aligned}$$

where $\tilde{r}_t$ is the notional *shadow interest rate*; i.e., the interest rate which the central bank would like to set given current economic conditions if it had not been constrained by the ELB.

State-dependent policy rules: FG (cont'd)

- The parameter $\iota \in \{0, 1\}$ determines whether the shadow rate depends on the lagged realised interest rate ($\iota = 1$), or on the lagged shadow rate ($\iota = 0$) like in Debortoli et al. (2019).
- For $\iota = 0$, the shadow rate keeps track of the severity of a recession or of a shortfall of inflation and makes the period for which the interest rate is kept at the ELB depend on the severity of the respective event; i.e., the interest-rate rule embeds *state-dependent FG*.
- As the assumption of *fully credible*, or "strong", FG is arguably unrealistic, we consider two modifications:
  - "weak" FG: a (large) share of private-sector agents does not believe in the central bank's guidance (i.e., its history-dependent policy)
  - "enhanced" FG: asset purchases increase the share of agents believing in the guidance relative to case of weak FG, due to a "signalling effect"

State-dependent policy rules: AP and G

- State-dependent asset-purchase (AP) rule:

$$a_t \quad = \quad \rho_{a,1}\, a_{t-1} + \rho_{a,2}\, a_{t-2} + \alpha_a\, \max[\, r_t^{gap} - c_a,\, 0\,],$$

  where α_a determines the *strength* of the asset purchases, and c_a is a threshold parameter determining the *immediacy* of the purchases.

- State-dependent fiscal-stimulus (G) rule:

$$f_t \quad = \quad \rho_f\, f_{t-1} + \alpha_f\, \max[\, r_t^{gap} - c_f,\, 0\,],$$

  where α_f determines the strength of the *spending-based* fiscal stimulus, and c_f is a threshold parameter.

- The variable r_t^{gap} is a measure of the *current interest-rate shortfall* implied by the model's interest-rate rule when $\iota = 1$.

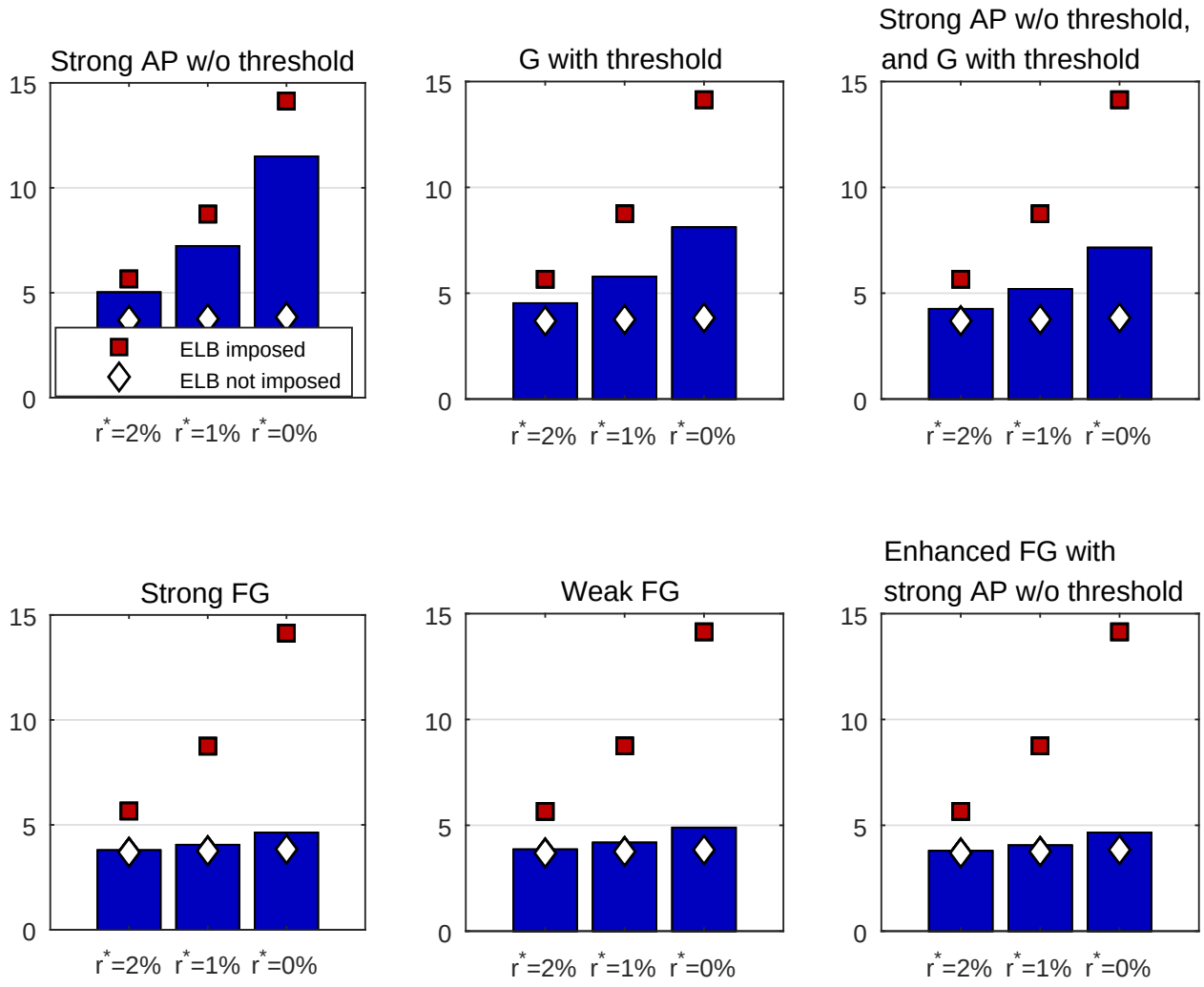
ELB incidence and impairment of steady-state distributions

	ELB incidence	Inflation		Output gap	
		Mean	Std	Mean	Std
A. No state-dependent policies					
with ELB					
$r^* = 2\%$	6.06	1.23	2.84	-2.35	8.07
$r^* = 1\%$	10.45	0.36	4.40	-5.59	11.56
$r^* = 0\%$	15.87	-1.15	6.97	-11.44	17.21
without ELB					
$r^* = 2\%$	—	1.90	1.75	0.00	5.62
$r^* = 1\%$	—	1.90	1.76	0.00	5.75
$r^* = 0\%$	—	1.90	1.77	0.00	5.91

Note: The reported statistics are computed from the model's steady-state distributions obtained for alternative values of its steady-state short-term real interest rate $r^* = 400 \cdot \log(\bar{R}^r)$, expressed in annualised percentage terms.

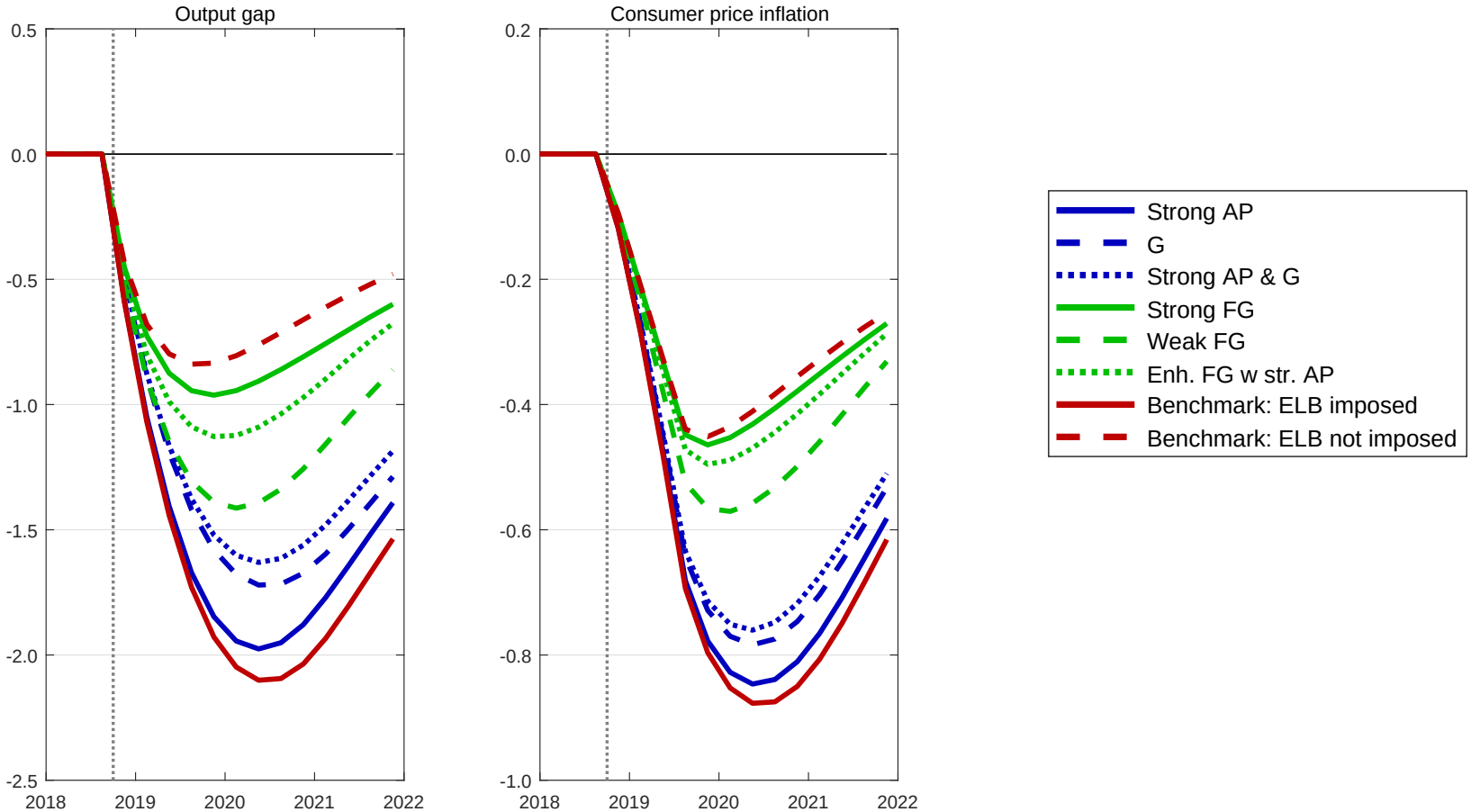
Overall stabilisation performance: Average RMSDs

Details



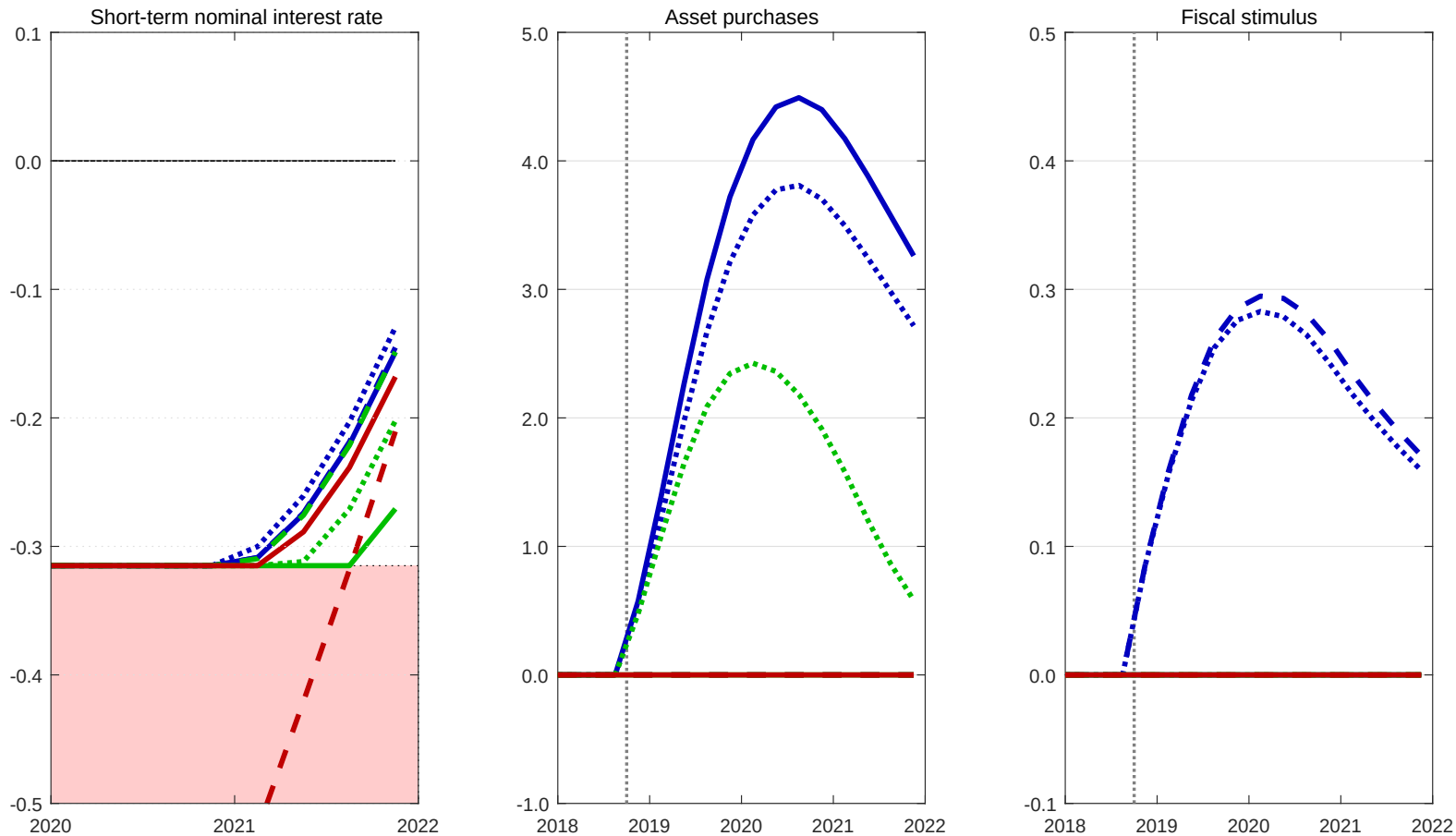
Note: This slide depicts the average root mean-squared deviations (RMSDs) of the model's steady-state distributions for inflation and the output gap for alternative values of its steady-state short-term real interest rate $r^* = 400\log(\bar{R}^r)$, expressed in annualised percentage terms.

Effects of an adverse demand shock



Note: The output gap and and consumer price inflation are measured, respectively, as a percentage of potential output and in terms of annual percentage rates. The effects of the demand shock on the output gap and inflation are shown as percentage-point deviations from the baseline values of the December 2018 ECB staff macroeconomic projection exercise.

Effects of an adverse demand shock (cont'd)



Note: The short-term nominal interest rate corresponds to the 3-month EURIBOR, expressed in annualised percentage terms. Asset purchases refer to the central bank's asset holdings, expressed as a percentage of annual GDP, and fiscal stimulus refers to government spending, expressed as a percentage of quarterly GDP. The effects of the demand shock on asset holdings and government spending are shown as deviations from baseline values.

Summary (1)

- According to our analysis based on NAWM II, the ELB gives rise to quite significant costs if unaddressed.
- Asset purchases and fiscal stimulus by themselves do redress part of the distortions due to the ELB constraint:
  - If strong asset purchases are combined with fiscal stimulus, the average of the RMSDs for inflation and the output gap drops from 14.1% to 7.1% when $r^* = 0\%$.
  - This involves quite substantial asset purchases of, on average, 16% of GDP and a sizeable fiscal stimulus of about 0.75% of GDP.
  - The ELB incidence is not very much affected though.

Summary (2)

- Forward guidance on interest rates is most powerful and can largely undo the distortionary effects due to the ELB, even if $r^* = 0\%$:
  - Strong forward guidance may not be realistic, ...
  - ... but a combination of weak forward guidance, asset purchases and fiscal stimulus is equally effective, in particular when asset purchases enhance the credibility of the forward guidance.
  - In accordance with its low-for-longer element, the number of times the short-term nominal interest rate stays at the ELB does rise from about 16% to about 26% when $r^* = 0\%$.
  - The amount of assets to purchase is reasonable, as is the required fiscal stimulus, but it can still be substantial in extreme circumstances.

Conclusions

- Our findings are of relevance for the review of monetary policy frameworks some major central banks have embarked on and suggest:
  - it is of utmost importance to maintain an approximate 2% inflation buffer to not compound the distortions due to the ELB in an environment with a low equilibrium real rate
  - there may be no need to raise the prevailing inflation targets from around 2% to higher values as long as effective non-standard tools are at the disposal of central banks
- More analysis is needed to investigate the robustness of these findings using different modelling frameworks.

Background slides

The original version of the NAWM ▸ M

- The NAWM is a small-open-economy extension of the Smets-Wouters model and designed for forecasting and policy analysis at the ECB:
  - agents: households, (intermediate and final-good) firms, central bank and fiscal authority ▸ A
  - real and nominal frictions: habit formation, adjustment costs, sticky prices and wages, limited exchange-rate pass-through, ... ▸ F
  - financial frictions: (exogenous) domestic and external risk premia
  - Rest-of-the-World block (SVAR)
- Details are provided in Christoffel et al. (2008, 2011).

Original NAWM: Agents

▸ OM

- Households: consume, accumulate physical capital, supply differentiated labour services, set wages in monopolistically competitive markets, trade in domestic and foreign bonds.
- Firms: produce tradable intermediate and non-tradable final goods
  - domestic intermediate-good firms: use labour and capital services as inputs, produce tradable differentiated goods, set prices in *producer* currency in monopolistically competitive markets at home and abroad
  - foreign intermediate-good firms: sell differentiated goods in domestic markets, set prices in *local* currency in monopolistically competitive markets
  - final-good firms: combine domestic and foreign intermediate goods into three non-tradable goods: a private consumption good, a private investment good, a public consumption good

Original NAWM: Agents

▸ OM

- Central bank: sets the short-term nominal interest rate by following a Taylor-type interest-rate rule.
- Fiscal authority: purchases public consumption goods, issues bonds, levies distortionary as well as lump-sum taxes.

Original NAWM: Frictions and shocks

▸ OM

- The NAWM features a relatively large number of frictions:
  - external habit formation in consumption
  - generalised adjustment cost in investment, imports and exports
  - fixed cost in intermediate-good production
  - monopolistic competition in intermediate-good and labour markets
  - sticky prices and wages à la Calvo, with dynamic indexation
  - domestic and external financial intermediation costs
  - non-state-contingent bonds
- In addition, the model contains a relatively large number of shocks (classified as demand, technology, mark-up and foreign shocks, plus a monetary policy shock).

The financial extension of the NAWM ▸ M

- Households face a "loan-in-advance (LIA)" constraint:
  - households accumulate physical capital, the services of which they rent out to firms
  - capital investments have to be financed by new bank loans (Carlstrom et al., 2017)
- Financial intermediaries ("banks") engage in maturity transformation:
  - banks offer long-term loans to the private sector to finance capital investments and hold domestic and foreign long-term government bonds
  - banks' long-term assets are modelled as nominal consoles with geometrically decaying coupons à la Woodford (2001)
  - banks fund their assets with short-term household deposits and with their equity/net worth (accumulated through retained earnings)
- Firms' foreign trade is intermediated by banks.

The financial extension of the NAWM (cont'd)

▸ EM

- Imperfect financial markets:
  - the option to abscond ("agency problem") limits the leverage of banks (Gertler and Karadi, 2011 and 2013)
  - banks' capital position influences the transmission of shocks ("financial accelerator" mechanism)
- Delayed pass-through to lending rates:
  - loans are originated by funding-constraint "wholesale banks"
  - monopolistically competitive "retail banks" (Gerali et al., 2011) distribute loans and adjust loan rates sluggishly
- Exogenous financial disturbances:
  - shock to "survival rate" of wholesale banks ($\rightarrow$ net worth)
  - shock to "mark-down parameter" of retail banks ($\rightarrow$ market power)

The financial extension of the NAWM (cont'd)

▸ EM

- Central bank can purchase long-term private-sector loans and/or government bonds:
  - relief of banks' balance sheets/leverage constraints ("stealth recapitalisation") and improvement of lending conditions
  - banks' holdings of foreign currency-denominated bonds accounts for exchange-rate channel of asset purchases
- Details are provided in Coenen et al. (2018).

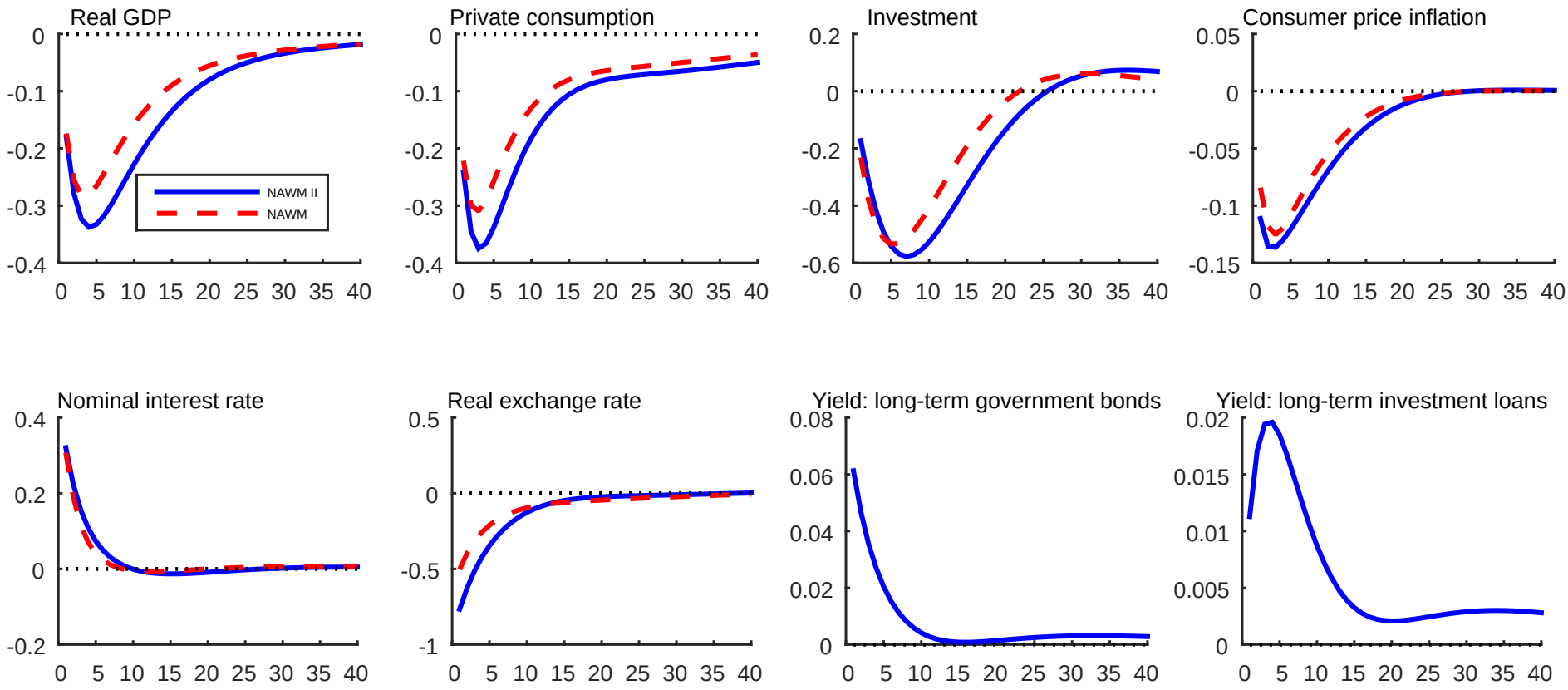
▸ Transmission of an interest-rate shock

▸ Effects of autonomous asset purchases

▸ Effects of autonomous government spending

Transmission of an interest-rate shock

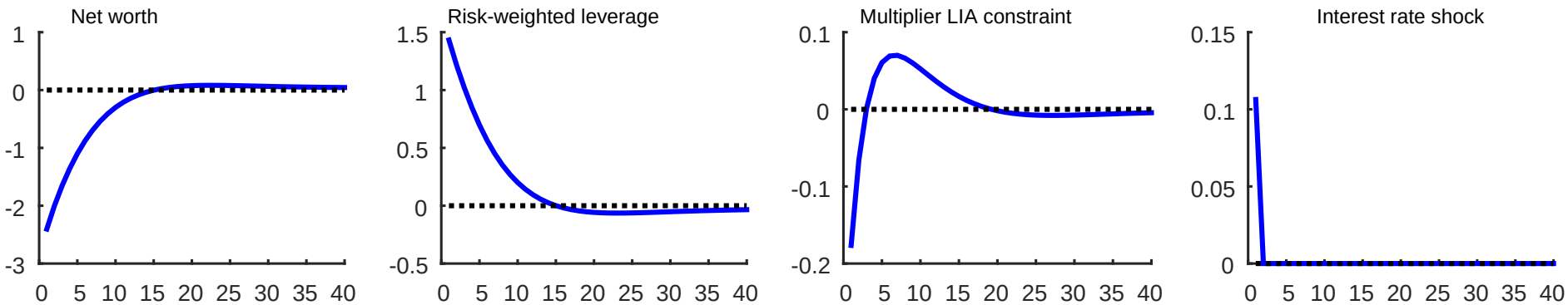
▸ EM



Note: This slide depicts the impulse responses of selected domestic variables to an interest-rate shock equal to one standard deviation. All impulse responses are reported as percentage deviations from the model's non-stochastic balanced growth path, except for the impulse responses of the inflation and interest rates which are reported as annualised percentage-point deviations.

Transmission of an interest-rate shock (cont'd)

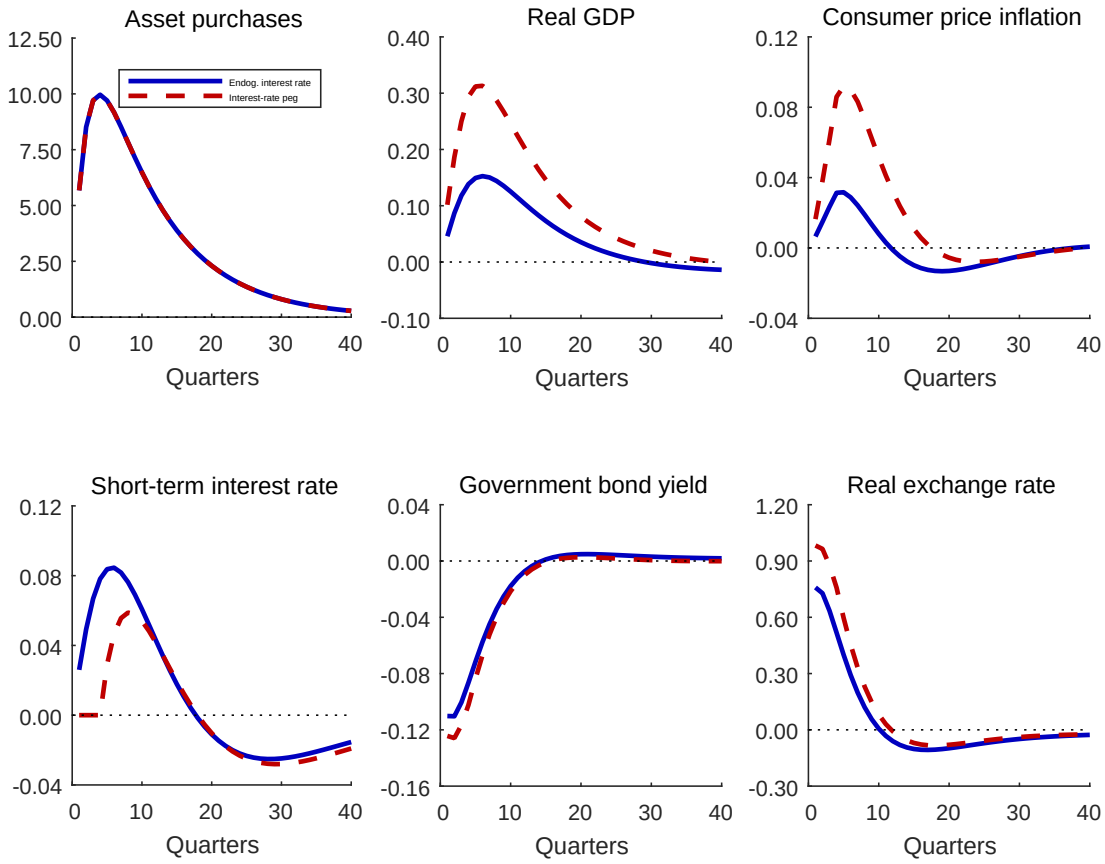
▸ EM



Note: See above.

Effects of autonomous asset purchases

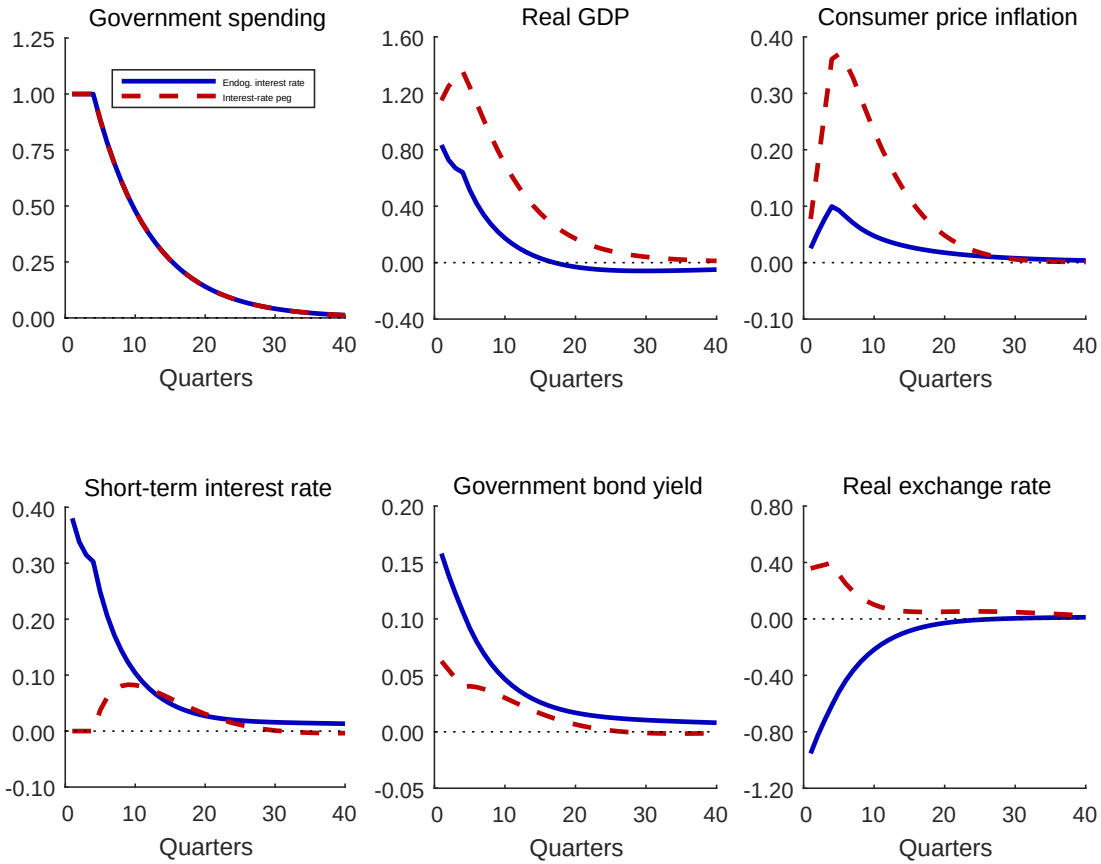
▸ EM



Note: This slide depicts the effects of a hump-shaped asset purchase shock. The size of the shock is calibrated such that the central bank's asset holdings reach a peak of 10% of GDP after 4 quarters. The effect are shown for the cases with endogenous interest-rate reaction and with interest rates unchanged for 4 quarters and imperfect credibility of the central bank's announcement thereof. The effects are reported as percentage deviations from the model's steady state, except for the effects on inflation and interest rates which are reported as annualised percentage-point deviations.

Effects of autonomous government spending

▸ EM



Note: This slide depicts the effects of an anticipated increase in autonomous government spending equal to 1% of GDP, which lasts 4 quarters and gradually decays thereafter. The effect are shown for the cases with endogenous interest-rate reaction and with interest rates unchanged for 4 quarters and imperfect credibility of the central bank's announcement thereof. The effects are reported as percentage deviations from the model's steady state, except for the effects on inflation and interest rates which are reported as annualised percentage-point deviations.

State-dependent policy rules: Parametrisation

back

- Interest-rate rule with ELB:
  - $100 \cdot \log(\bar{R}) = 100 \cdot \log(\bar{R}^r) + 1.9/4$; $ELB = -0.315/4$ or $-0.35/4$ (depending on the exercise); and all other parameters set equal to the parameter estimates reported in Coenen et al. (2018)
- Asset-purchase (AP) rule:
  - $\rho_{a,1} = 1.5$ and $\rho_{a,2} = -0.54$ (with roots equal to 0.9 and 0.6); $\alpha_a = 0.5$ ("moderate"), $\alpha_a = 1$ ("strong"), or $\alpha_a = 0$ otherwise; $c_a = 1/4$, or $c_a = 0$ otherwise
- Fiscal-stimulus (G) rule:
  - $\rho_f = 0.9$; $\alpha_f = 5$, or $\alpha_f = 0$ otherwise; $c_f = 1/4$, or $c_f = 0$ otherwise

ELB incidence and impairment of distributions

back

	ELB incidence	Inflation		Output gap	
		Mean	Std	Mean	Std
B. State-dependent policies with ELB: No FG					
strong AP					
$r^* = 2\%$	5.99	1.46	2.35	-1.48	6.82
$r^* = 1\%$	10.69	0.83	3.30	-3.60	8.76
$r^* = 0\%$	16.96	-0.44	5.22	-8.00	12.47
G with threshold					
$r^* = 2\%$	5.94	1.52	2.26	-1.38	6.62
$r^* = 1\%$	10.41	1.06	2.92	-3.09	7.94
$r^* = 0\%$	16.32	0.27	4.05	-6.28	10.05
strong AP & G with threshold					
$r^* = 2\%$	5.88	1.59	2.12	-1.07	6.28
$r^* = 1\%$	10.52	1.19	2.65	-2.44	7.25
$r^* = 0\%$	16.80	0.41	3.68	-5.20	8.93

ELB incidence and impairment of distributions

back

	ELB incidence	Inflation		Output gap	
		Mean	Std	Mean	Std
C. State-dependent policies with ELB: FG					
strong FG					
$r^* = 2\%$	8.06	1.86	1.81	-0.27	5.77
$r^* = 1\%$	14.78	1.80	1.93	-0.68	6.13
$r^* = 0\%$	24.86	1.63	2.23	-1.66	6.81
weak FG					
$r^* = 2\%$	8.65	1.84	1.85	-0.36	5.85
$r^* = 1\%$	15.73	1.75	2.01	-0.87	6.29
$r^* = 0\%$	26.24	1.53	2.37	-2.02	7.09
enhanced FG with strong AP					
$r^* = 2\%$	8.23	1.86	1.82	-0.27	5.76
$r^* = 1\%$	15.14	1.79	1.94	-0.69	6.11
$r^* = 0\%$	25.57	1.58	2.29	-1.69	6.81

Sizes of state-dependent AP and G

back

	Asset purchases		Fiscal stimulus	
	Mean	95%	Mean	95%
strong AP				
$r^* = 2\%$	4.62	23.57	—	—
$r^* = 1\%$	11.18	62.81	—	—
$r^* = 0\%$	24.41	136.99	—	—
G with threshold				
$r^* = 2\%$	—	—	0.17	0.80
$r^* = 1\%$	—	—	0.42	2.50
$r^* = 0\%$	—	—	0.88	5.19
strong AP & G with threshold				
$r^* = 2\%$	3.42	19.52	0.12	0.57
$r^* = 1\%$	7.73	45.03	0.32	1.87
$r^* = 0\%$	16.12	86.69	0.75	4.41
enhanced FG with strong AP				
$r^* = 2\%$	0.72	3.65	—	—
$r^* = 1\%$	1.79	12.39	—	—
$r^* = 0\%$	4.41	29.72	—	—